

5.7 STAR TRACKER

The Space Station, which is large and fairly flexible, cannot measure its own position with a high degree of accuracy and thus cannot directly tell the AMS-02 where it is exactly and where it is pointing. To optimize science from the Tracker detector carried by AMS it is important to have the capability to determine accurately the position of the AMS payload at the exact time that an event occurs. To accurately determine its position, AMS carries a Star Tracker called AMICA (for Astro Mapper for Instrument Check of Attitude). AMICA is equipped with a pair of small optical telescopes (AMICA Star Tracker Cameras or ASTCs). The ASTCs are mounted to the upper Vacuum Case Conical Flange on opposite sides of AMS to increase the probability that one has a clear view of the stars (Figure 5.7-1 and 5.7-2). The positioning of the Star Trackers while in the Shuttle Payload Bay does not place the ASTCs within nominal EVA translation paths. The location atop of the tracker places the ASTCs outside of EVA translation paths on the ISS and EVA operations that may be performed on the AMS-02 are not in proximity of the Star Trackers.

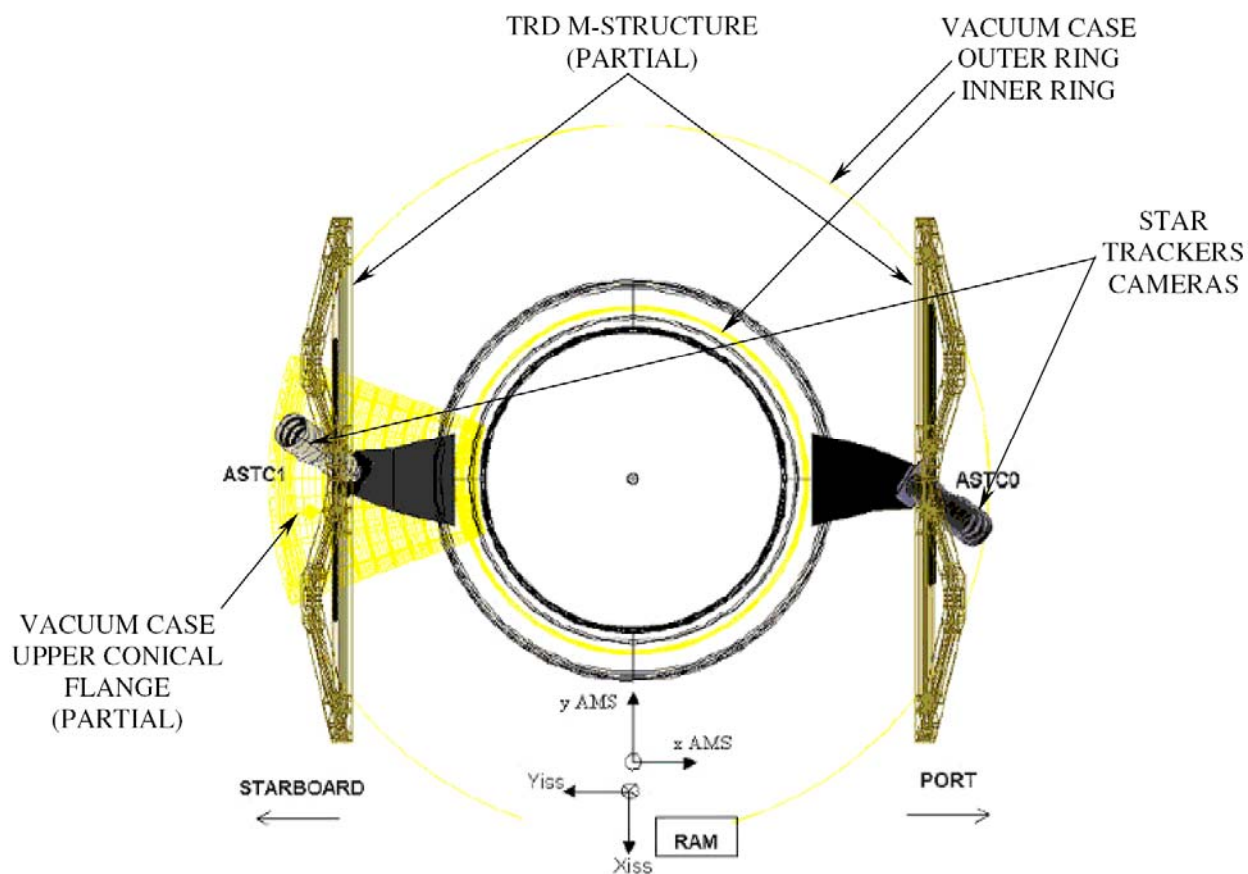


Figure 5.7-1 Star Tracker Position on the AMS-02

Each camera acquires an image of the stars with a Charged Coupling Device (CCD) detector and compares the resultant image to an on-board sky map. With this information, the attitude of AMS can be determined within a few arc-seconds (arc-sec) accuracy.

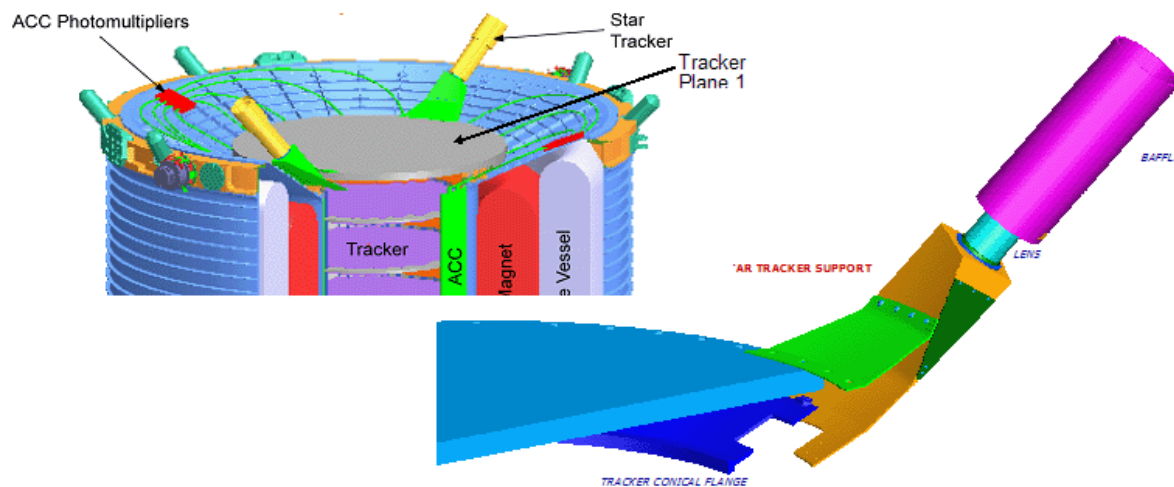


Figure 5.7-2 Star Tracker Mounting on the AMS-02

The hardware consists of an optics system [$f/1.25$ lens with 75 mm focal length and a $6.3^\circ \times 6.3^\circ$ field of view (FoV)]; a lens cover containing a 3 mm thick blue filter and a 2 mm thick red filter; a low noise frame-transfer CCD (512 X 512 pixels); and a baffle to limit the stray light intrusion to the optics. The baffle is made of black anodized aluminum Al 6061 that is 1 mm thick. The Star Tracker optical components are shown in Figures 5.7-3 and 5.7-4. The baffle is not mechanically connected to the lens assembly and is supported independently by a bracket mounting the baffle to the M-Structure, the configuration allowing for relative motion between the baffle and the lenses without leaking light into the optical path. The interface between the baffle and the lens assembly is made light tight by a fabric MLI cover.

The interior of the baffle is being considered sharp enough to cut EVA gloves, the interior of the baffle cannot be rounded to meet the sharp edge requirements without losing the optical properties of a baffle to limit stray light.

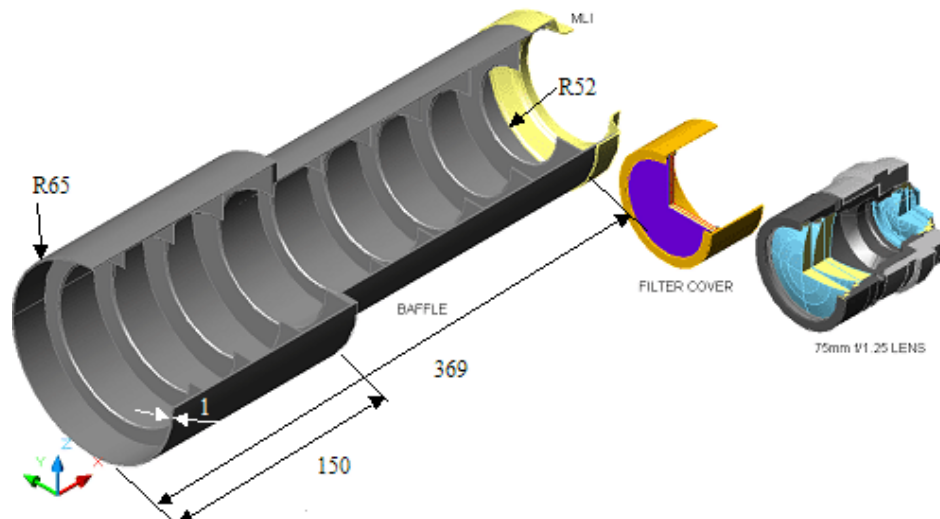


Figure 5.7-3 Star Tracker Optical Components

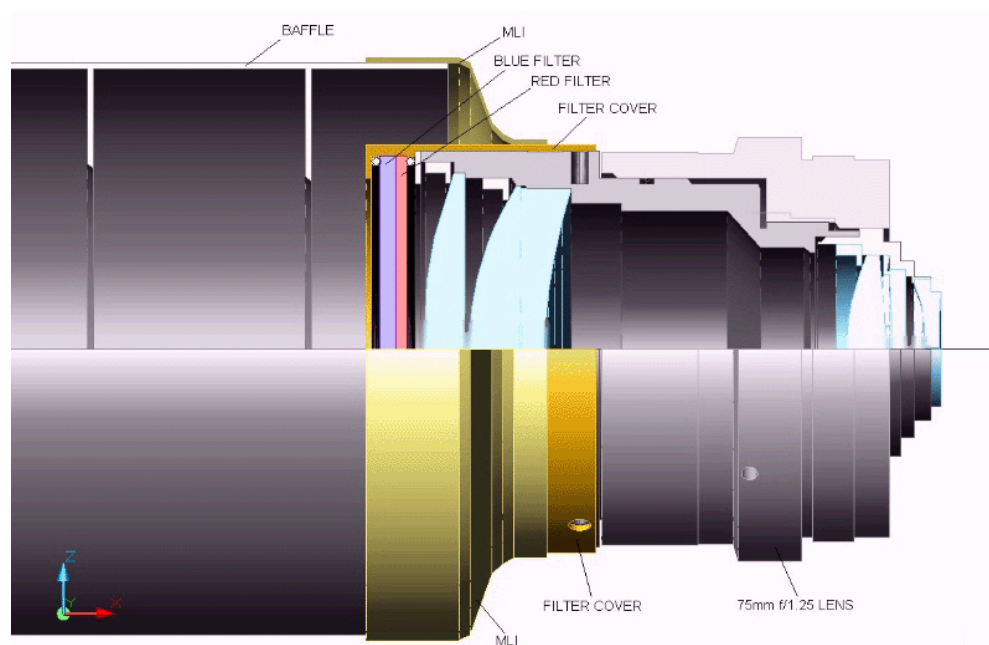


Figure 5.7-4 Star Tracker Optics

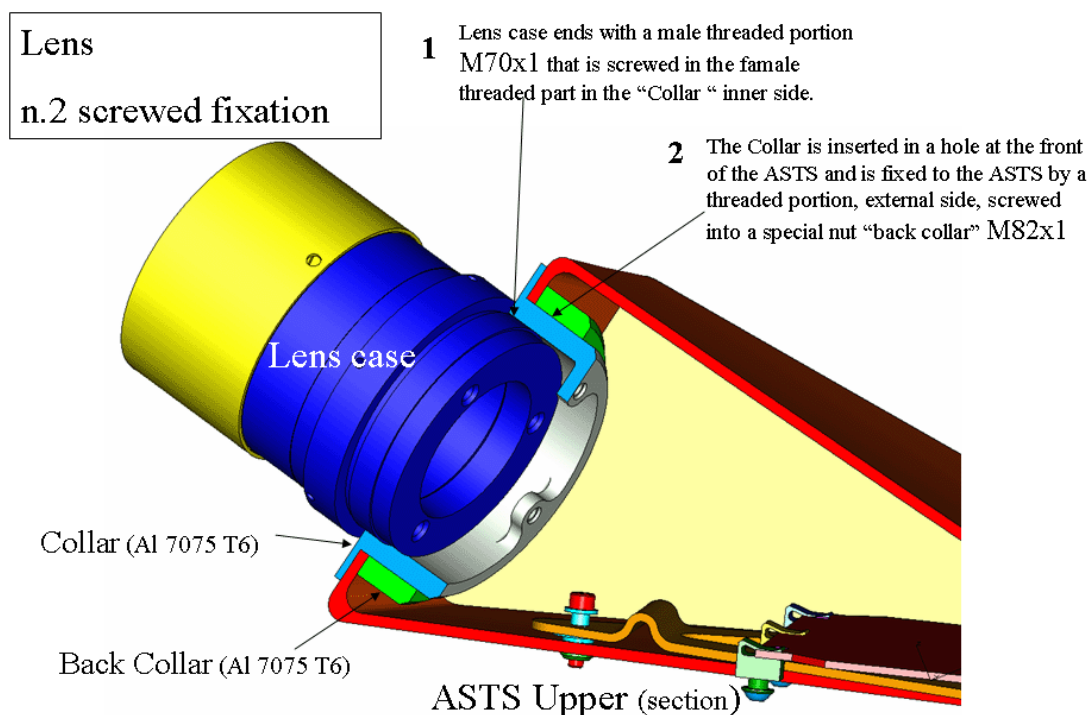


Figure 5.7-5 Star Tracker Lens Mounting

The AMICA lenses utilize standard optics mounting techniques (Figure 5.7-5) attaching to the housing body and in the construction of the lenses and filters. There is no specific

venting paths provided for in the design of the lens assemblies, however the threaded body provides ample venting paths as shown during venting tests.

The enclosed volume of the Star Tracker is vented through the fastener access holes that are used for tool access when installing the Star Tracker to the AMS-02 as shown in Figure 5.7-6.

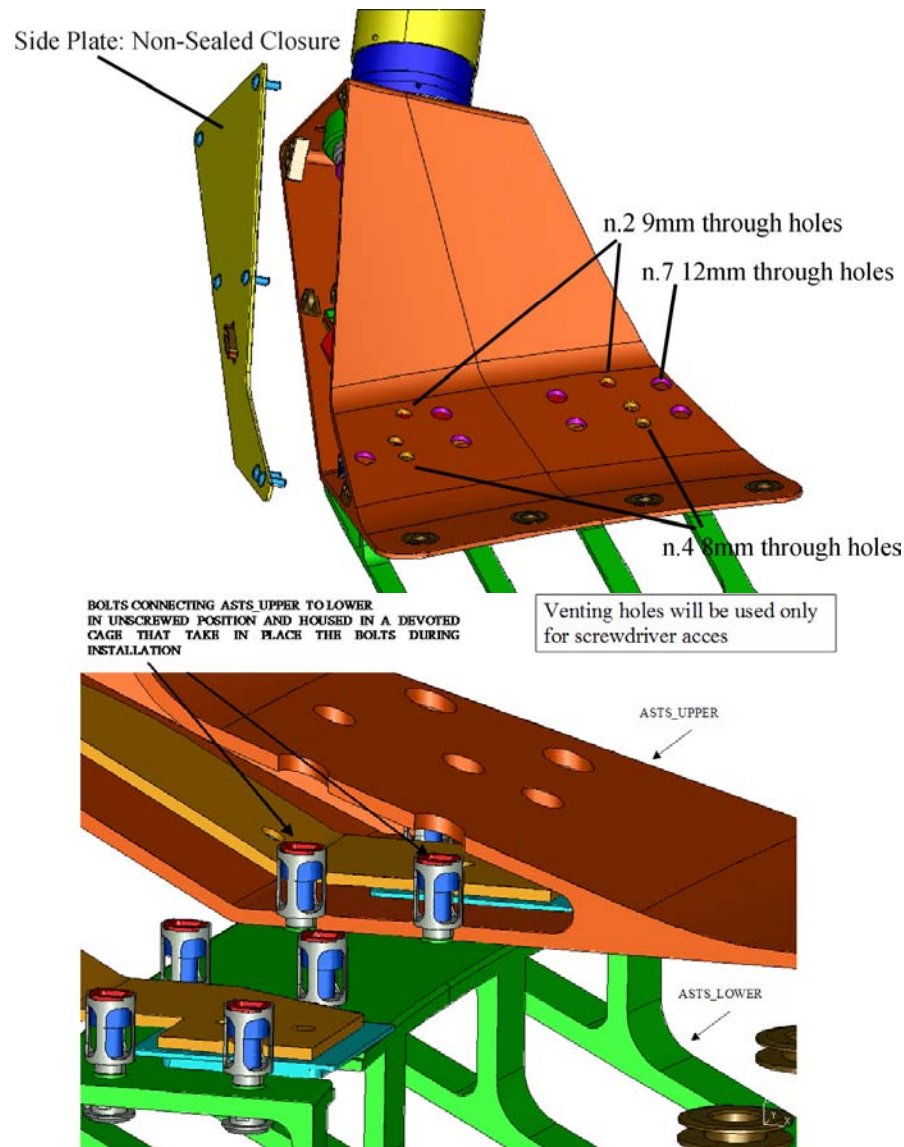


Figure 5.7-6 Star Tracker Assembly and Venting Paths

The AMICA operates on 28 Vdc and converts power internally to +35 V, +12 V, +7 V and +5 V distributed power. One small section of the circuitry operates at a maximum of

+45 V. The boards are conformally coated to reduce any potential for high voltage effects. The ASTCs are interfaced to the M-crate located on the ram side by three cables, two 8 conductor 24 AWG shielded conductors to provide the SpaceWire Link for data and one three conductor 22 AWG cable for power. The thermal load from the Star Tracker CCD and electronics board inside the sensors is carried by a copper “bus” to the thermal blocks connecting to the Tracker Thermal Control System (Figure 5.7-7). The electronics unit is based on a VME bus, which contains the processor (DSP21020) and power switching boards. The CCD and power switching boards for each ASTC are contained in the AMICA Star Tracker Supports (ASTSs) that attach the instrument to the Tracker.

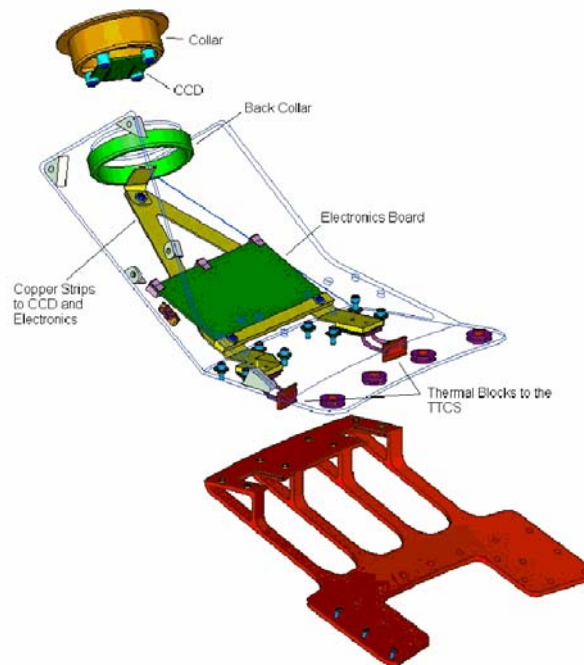


Figure 5.7-7 Star Tracker Thermal Interface and CCD Electronics